PATENT SPECIFICATION (11) 1 498 621

1 498 621

(21) Application No. 11621/74 (22) Filed 15 March 1974

(23) Complete Specification filed 16 June 1975

(44) Complete Specification published 25 Jan. 1978

(51) INT. CL.² F28F 7/00

(52) Index at acceptance

F4S 4X

(54) NEW OR IMPROVED HEAT EXCHANGER

(71) I, RONALD WILLIAM PAGE, a British subject of 18, Old Mill Avenue, Cannon Park, Canley, Coventry in the County of Warwick, do hereby declare the invention for which I pray that a patent may be granted to me and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to a heat exchanger of the type in which useful heat is extracted from stale exhaust air and used to preheat incoming fresh air in a heating system for an enclosed space such as a room in a building. The invention is envisaged as being particularly for application to the heating systems of relatively large enclosed spaces, e.g. ballrooms, cinemas and like public places or factory or office spaces.

Thus, the invention is concerned with a heat exchanger for air to air heat exchange where the temperature differentials are small. As heat exchange has to take place through some form of medium separating the two air flows this requires a large surface area for the heat exchange medium to ensure maximum possible efficiency in recovery of useful heat from the waste exhaust air and this brings in the problem of keeping the heat exchanger down to an acceptable overall size whilst still providing the necessary large surface area for heat exchange to take place.

The object of the invention is to provide a new or improved form of heat exchanger which is particularly adapted for the application to the cases referred to above and which will provide the desired large surface area for heat exchange whilst maintaining an acceptable overall size for the heat exchanger itself.

According to the invention I provide an air to air heat exchanger comprising a framework and an elongate membrane strip (as hereinafter defined) supported by the framework in a series of hairpin loops, alternate loops having their open mouths facing in opposed directions, the framework blocking the side edges of each loop except at a position remote from the mouth thereof where at least one of said edges affords a side passageway, each loop providing a passage for air between the mouth and the or each side passageway and alternate such passages being adapted for respective connection to first and second air supplies.

The expression "membrane" as used herein means a sheet material sufficiently thin to permit heat exchange through it and substantially impervious to air.

The framework may comprise upper and lower bar members around which the membrane passes to define the loops, the upper members being spaced by vertical upper side members, the lower members being spaced by vertical lower side members and the vertical upper and lower side members being interleaved and secured together at positions spaced from both the upper and the lower members.

The expressions "vertical" and "horizontal" are used for convenience of description only as it will be appreciated that the heat exchanger can be used in any orientation.

In use, the heat exchanger may be operated by causing first and second air supplies to flow in alternate passages in generally opposed directions over at least a portion of the length of the passages.

One embodiment of the invention is described hereinafter by way of example only and with reference to the accompanying diagrammatic drawings in which:

FIGURE 1 is a view of the framework of a heat exchanger made in accordance with the invention but with the flexible membrane not shown in the drawing.

FIGURE 2 is a view showing the form taken by the flexible membrane as it would

be if fitted in the frame of Figure 1, and

FIGURE 3 is an end-on view in exploded fashion showing the framework of Figure 1 with the membrane of Figure 2 supported by such framework.

It will be appreciated that the drawings are of a diagrammatic nature and it will be gathered from the following description that the framework shown in Figure 1 constitutes a basic unit of framework which in itself would be suitable for a small capacity heat exchanger but which can be extended by repetition to form a heat exchanger of any desired capacity.

Referring firstly to Figure 2, this illustrates the form taken by the flexible membrane when it is actually in place in the framework. The membrane itself is made of a suitable thin, flexible material such as polythene sheet, for example, and when arranged in the framework it follows a path which is made up of a series of hairpin loops. A continuous length of membrane such as polythene sheet may be used or it may be made up from a number of smaller length sheets attached end to end by suitable means, such as seam welding.

It will be observed from Figure 2 that the form of the membrane provides a series of side by side passages, one of such passages having two spaced apart parallel side walls 10 and 11 with a closed top wall 12 and an open mouth 13 at the bottom. At each end, as indicated at 14, the passage is open. It will be observed that the next adjacent passage is of the same construction but in inverted relationship so that its open mouth 15 is directed in the opposite direction from the open mouth 13. Such adjacent passage has a closed bottom wall 16 and open ends 17 and 18.

Referring now to Figure 1, the framework shown therein is made up of straight elongate lower bar members 19, and 20, and upper bar members 21 and 22 arranged horizontally in spaced apart parallel relationship. These bar members, may be made of wood or may be made as light gauge metal sections.

The lower bar members 19 and 20 are held apart in spaced parallel relationship by means of shorter, lower side members 23 and 24 secured between the opposite ends of the members 19 and 20 and extending at right angles thereto. Similarly, the upper bar members 21 and 22 are held apart at their opposite ends by shorter upper side members 25 and 26 to which they are secured. The upper side members 25 and 26 are interleaved with, and secured to the lower side members 23 and 24 at positions spaced from both the upper and lower bar members.

Referring now to the exploded end view of Figure 3, it will be seen how the membrane 10 is arranged in the framework of Figure 1 so as to provide the arrangement of a series of hairpin loops. It will be appreciated that starting from the basic frame unit, illustrated in Figures 1 and 3, a complete frame of any desired size can be built up by adding further elongated bar members such as 19, 20, 21 and 22 and further side members such as 23, 24, 25 and 26. Arrows are used to indicate a typical air flow through the unit of framework illustrated in Figure 1 and the solid line arrows indicate one path of air-flow whilst the dotted line arrows indicate another air-flow path. For example, the solid line arrows might be warm stale exhaust air whilst the dotted line arrows might be fresh air to be heated, or vice versa. This arrangement is given by way of example and it will be understood that the direction of flow could be the reverse of that indicated, with inlets and outlets reversed, or that only one air-flow path could be reversed if desired. If only one path is reversed, the general direction of air-flow of both fresh and stale air is the same.

Considering Figure 1, the warm waste exhaust air passes downwardly through inlet openings 30 into two passages formed by the opposed walls of the membrane and then outwardly through outlet openings afforded by the side passageways 31 towards the lower end of the frame. Incoming fresh air enters through openings 32 of the alternate passages at the bottom of the frame and passes outwardly through side passageways 33 at the opposite ends of the frame. There are thus opposing air flow streams which flow in opposite directions through alternate passages of the frame unit providing a counter-flow heat exchange, over at least a portion of the length of the passages.

Both stale and fresh air are delivered to alternate passages of the heat-exchanger by suitable duct work (not shown) and the air flows coming from the outlets also enter suitable duct work which can be easily connected to the complete heat-exchanger, made up of one or more of the basic units illustrated in Figure 1.

It will thus be appreciated that by using a flexible membrane arranged in this fashion in a framework a very large surface area for heat exchange can be built up in a relatively small size overall unit which is, therefore, readily adaptable to the existing heat system of a room or building.

In practice it is necessary for the air to be delivered to the inlet by fans and for these fans to be on the delivery side so as to ensure that if there should be any imbalance of pressure between the two air streams inside the unit the consequential

movement of the flexible membrane will be such as to restrict the low pressure side on the membrane thus offering greater resistance to the fan supplying that side and building up the pressure on that side until a pneumatically stable and balanced condition is achieved.

A further advantage of the unit is that it can be built up from inexpensive materials, such as polythene or other suitable plastics material sheet and wooden frame members.

WHAT I CLAIM IS:—

1. An air to air heat exchanger comprising a framework and an elongate membrane strip supported by the framework in a series of hairpin loops, alternate loops having their open mouths facing in opposed directions, the framework blocking the side edges of each loop except at a position remote from the mouth thereof where at least one of said edges affords a side passageway, each loop providing a passage for air between the mouth and the or each side passageway and alternate such passages being adapted for respective connection to first and second air supplies.

2. An air to air heat exchanger according to Claim 1 wherein the framework comprises upper and lower bar members around which the membrane passes to define the loops, the upper members being spaced by vertical upper side members, the lower members being spaced by vertical lower side members and the vertical upper and lower side members being interleaved and secured together at positions spaced on both the supper and the lower members.

3. In use, a heat exchanger according to Claim 1 or Claim 2 wherein first and second air supplies are caused to flow in alternate passages, in generally opposed directions over at least a portion of the length of the passages.

4. A heat exchanger substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

FORRESTER, KETLEY & CO.,
Chartered Patent Agents,
Rutland House, Edmund Street,
Birmingham B3 2LD,
also at
Forrester House, Bounds Green Road,
London N11 2EY,
and
Scottish Provident Building,
St. Vincent Place,
Glasgow G1 2DT.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1978.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1 498621 COMPLETE SPECIFICATION
1 SHEET
This drawing is a reproduction of the Original on a reduced scale.

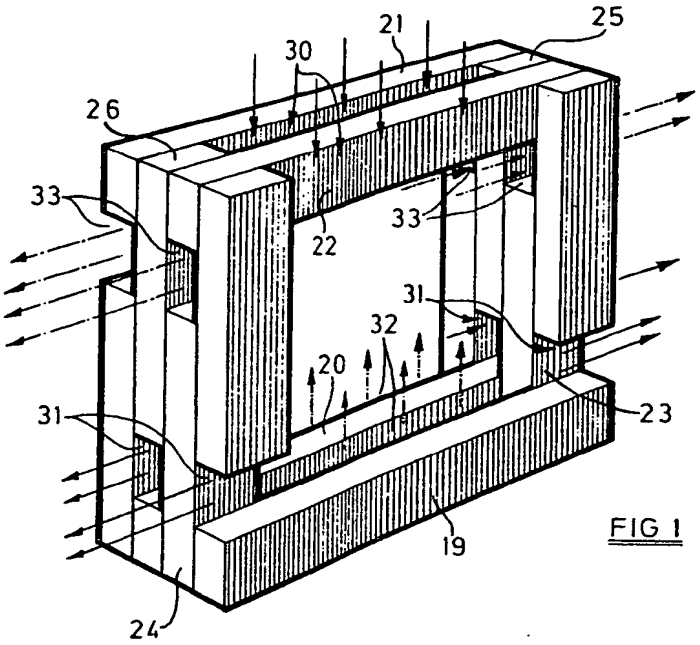

FIG 1

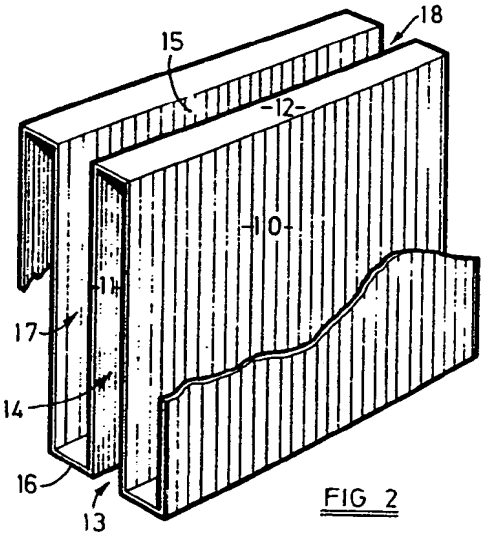

FIG 2

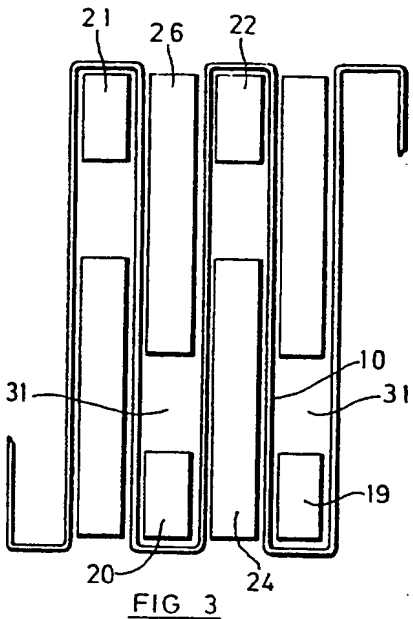

FIG 3